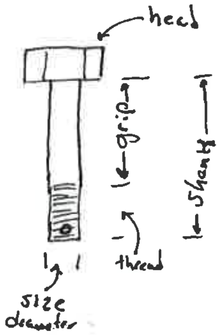
AEM 617

Aircraft Hardware

Bolts



Aircraft bolts are <u>usually</u> identified by

- AN (Army - Navy)
- NAS (National Aircraft Standard
- MS (Military Standard)

Usually a Nickel Chrome Moly Steel (8740)
or a Manganese Silicon Moly Steel (4037)
or an Al
or Stainless steel

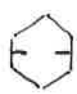
A standard aircraft bolt is sized by its identification #.

AN -<diam> - H - <length> - A

diameter in $\frac{1}{16}$ in
head drilled?
thread <u>NOT</u> drilled

e.g. AN-3-16A is an aircraft bolt of diameter $\frac{3}{16}$ in 
or AN3-16A
<u>without</u> a drilled head 
<u>without</u> a drilled shank 
of length $1\frac{25}{32}$ in with a $1\frac{3}{8}$ in grip.

Materials

AN3$\underbrace{\text{DD}}$16A 
2024 Al Alloy

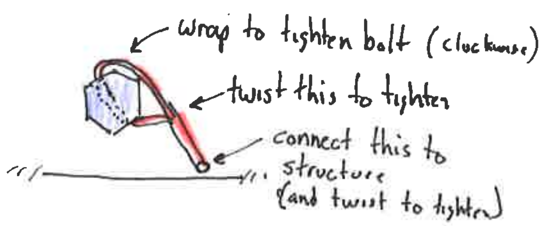
AN3-5
No letter indicates cd plated steel

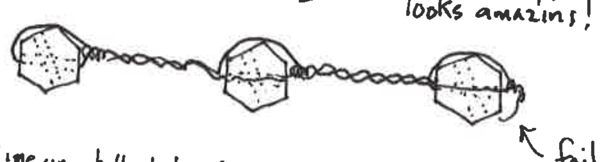
AN4$\underbrace{\text{C}}$5 
Corrosion resistant steel

Drilled Head.

Safety wire: A positive and visible method of preventing bolt rotation.

This is almost an <u>art</u>! A good safety wire job looks amazing!





1) line up bolt holes for clockwise tightening

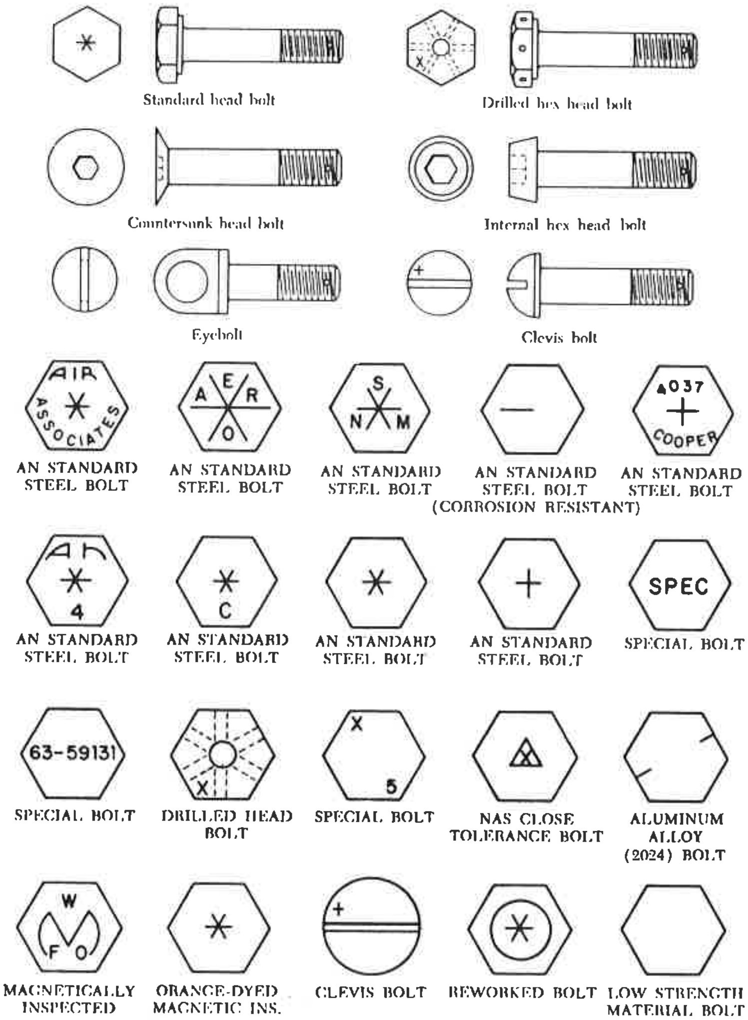


FIGURE 6–1. Aircraft bolt identification.

Nuts

Goes on the threaded portion of the bolt.....

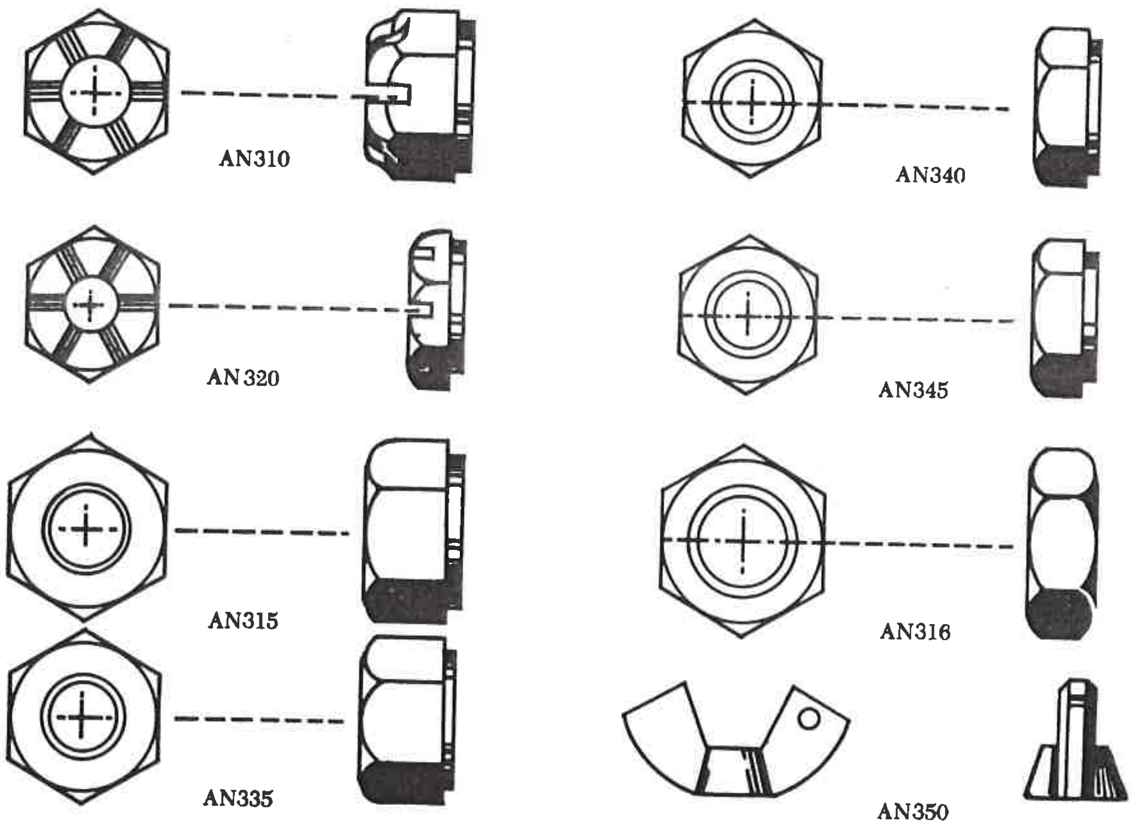
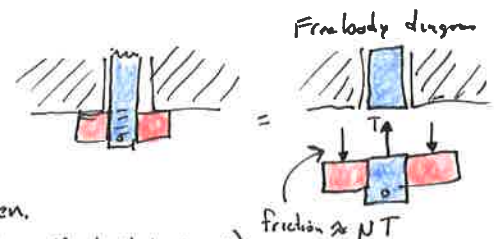


FIGURE 6–6. Non-self-locking nuts.

Non-Self locking

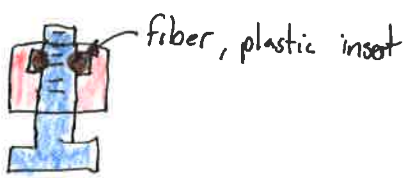


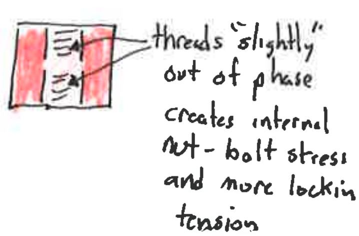
Loosening rotation prevented only by tightness + friction

In a high vibration environment, like an airplane, these nuts will loosen.
Must be safety wired or pinned. (Hense AN3-5 bolt with drilled shank!)

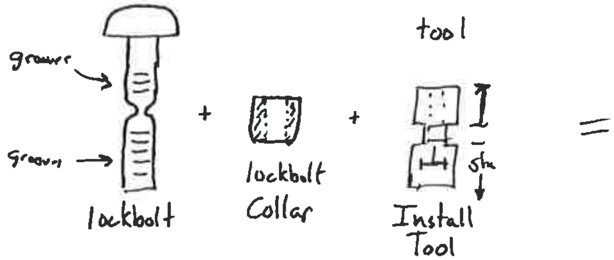
Self locking

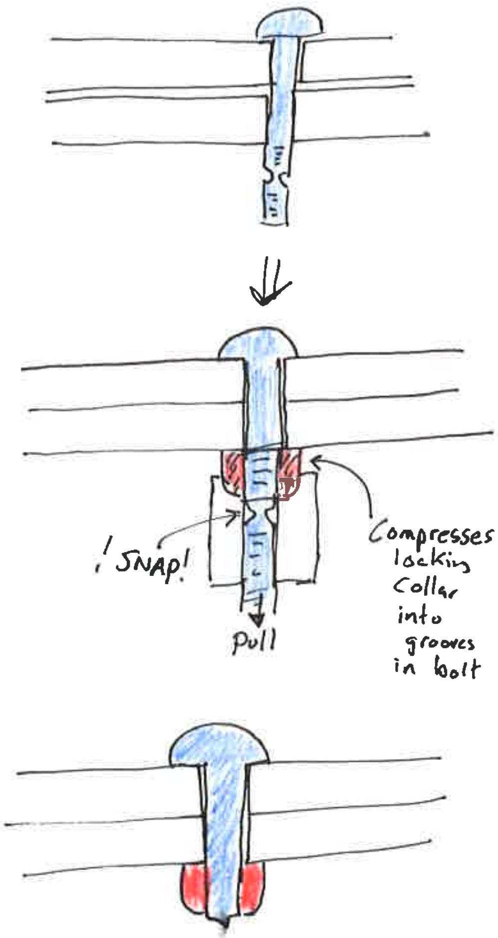
Many ways to increase rotational static friction without bolt tension





Lockbolt (bolt + rivet)





ALPP H T 8 8

- ALPP — head type "pan head"
- H — fit "interference"
- T — pin type — Steel
- 8 — diameter 1/32 in
- 8 — grip length 1/16 in

BL 8 4

- BL — blind lockbolt

≈ "pop" rivet cousin.

LC C 8

- LC — lockbolt Collar
- C — material
- 8 — diameter 1/32 in

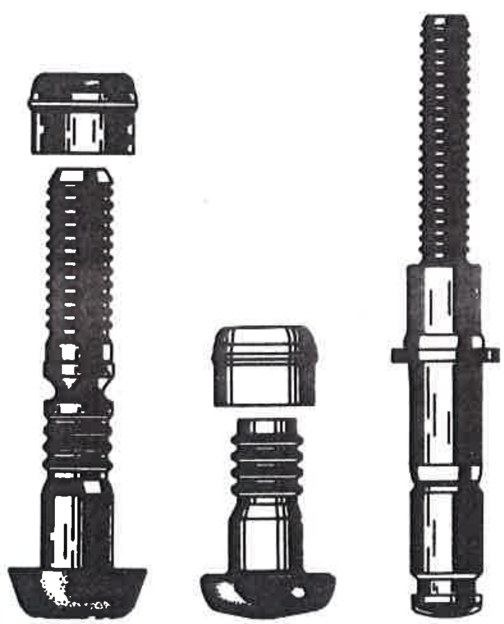


Figure 6–2. Lockbolt types.

Dzus "Zeus" / Camloc / Airloc

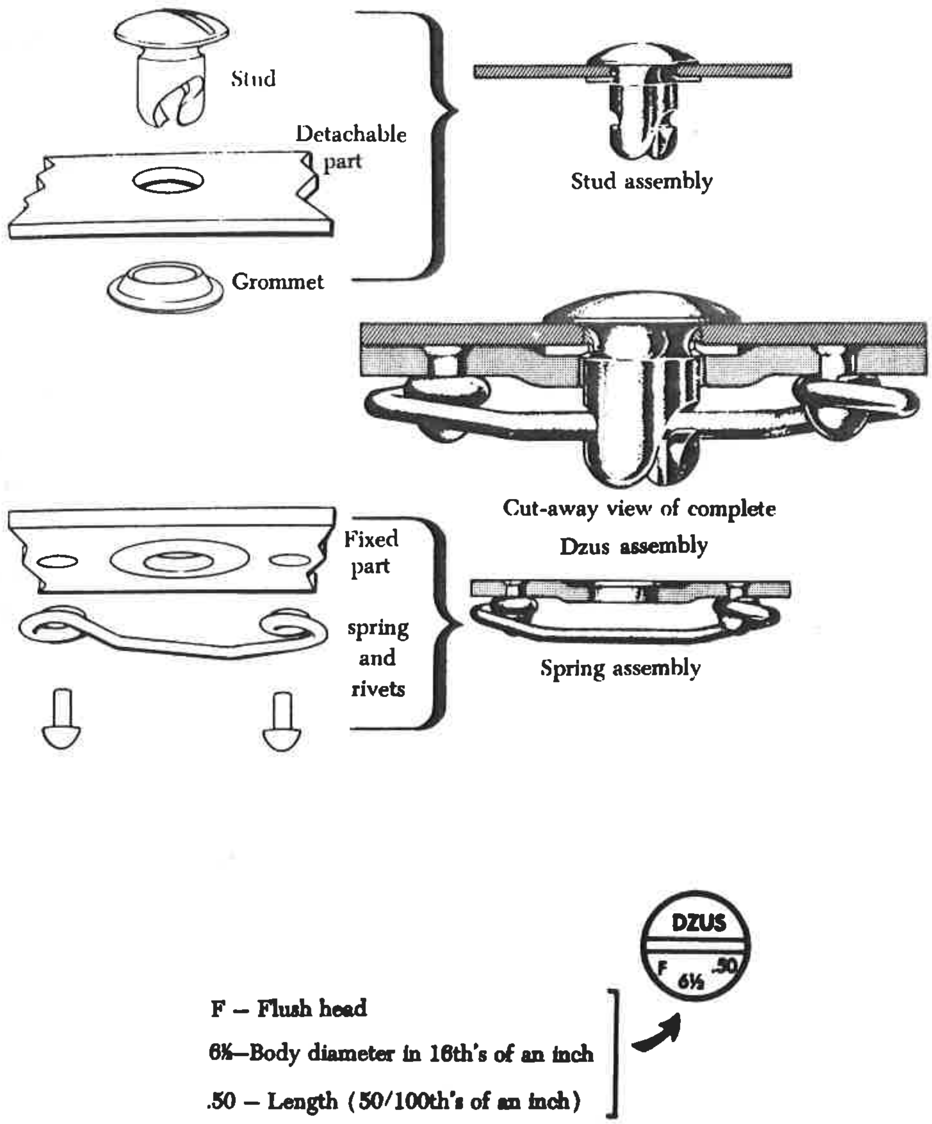
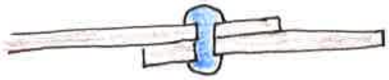
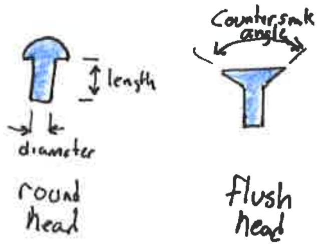


FIGURE 6–18. Dzus identification.

Rivets



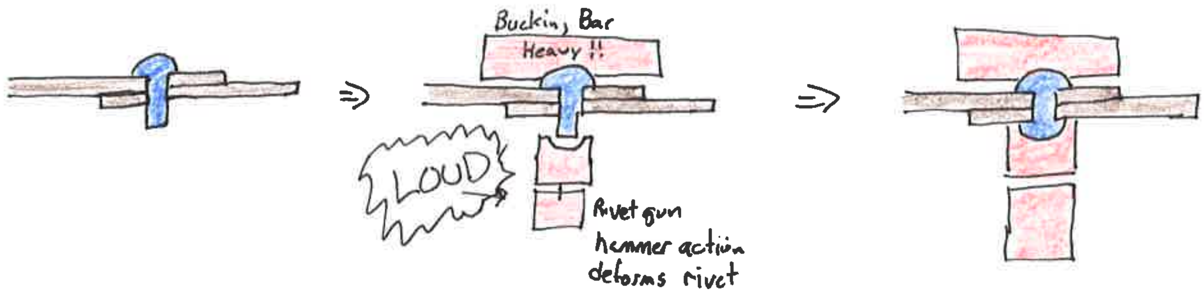
Light and strong joiner of sheet metal
(fast and cheap too!)



tiny.cc/AEM617Rivets

7:40

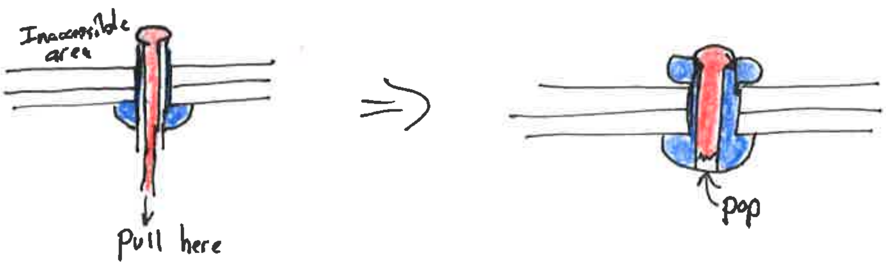
Install:



Heat Treating:

Some rivets require a special heat treating process before and during install.

"Pop" Rivets (call them blind rivets...)



Heavy, expensive, less strength, very convenient!

Rivet ID

Material	Head Marking	AN Material Code	AN425 78° Counter-Sunk Head	AN426 100° Counter-Sunk Head MS20426 *	AN427 100° Counter-Sunk Head MS20427 *	AN430 Round Head MS20470 *	AN435 Round Head MS20613 * MS20615 *	AN441 Flat Head	AN442 Flat Head MS20470 *	AN455 Brazier Head MS20470 *	AN456 Brazier Head MS20470 *	AN470 Universal Head MS20470 *	Heat Treat Before Using	Shear Strength P.S.I.	Bearing Strength P.S.I.
1100	Plain	A	X	X		X			X	X	X	X	No	10000	25000
2117T	Recessed Dot	AD	X	X		X			X	X	X	X	No	30000	100000
2017T	Raised Dot	D	X	X		X			X	X	X	X	Yes	34000	113000
2017T-HD	Raised Dot	D	X	X		X			X	X	X	X	No	38000	126000
2024T	Raised Double Dash	DD	X	X		X			X	X	X	X	Yes	41000	136000
5056T	Raised Cross	B		X		X			X	X	X	X	No	27000	90000
7075-T73	Three Raised Dashes		X	X		X			X	X	X	X	No		
Carbon Steel	Recessed Triangle				X		X MS20613 *	X					No	35000	90000
Corrosion Resistant Steel	Recessed Dash	F			X		X MS20613 *						No	65000	90000
Copper	Plain	C			X		X	X					No	23000	
Monel	Plain	M			X			X					No	49000	
Monel (Nickel-Copper Alloy)	Recessed Double Dots	C					X MS20615 *						No	49000	
Brass	Plain						X MS20615 *						No		
Titanium	Recessed Large and Small Dot			MS 20426				X					No	95000	

* New specifications are for Design purposes

FIGURE 6–33. Rivet identification chart.

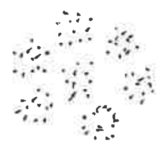
Cables

Specially twisted wires

7×7 ≡ 7 strands with 7 wires per strand

7×19 ≡ 7 strands of 19 wires

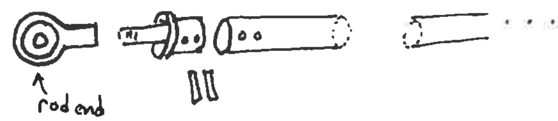
diameter



← this one is more flexible

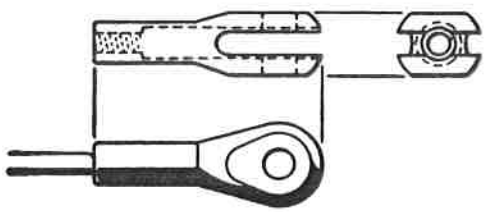
Terminals

Tube Linkage



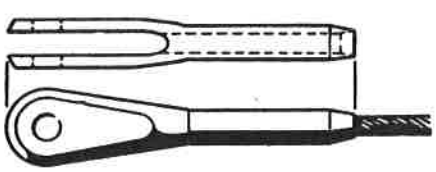
AN663 Double shank ball end terminal

AN664 Single shank ball end terminal

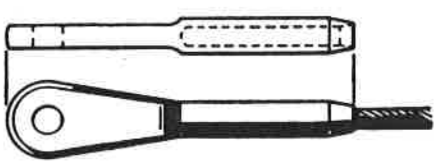


AN665 Rod end terminal

AN666 Threaded cable terminal



AN667 Fork end cable terminal



AN668 Eye end cable terminal

Fluid Lines

2. Medium pressure, pressures up to 3,000 p.s.i.
   One wire braid reinforcement.
   Smaller sizes carry pressure up to 3,000 p.s.i.
   Larger sizes carry pressure up to 1,500 p.s.i.
3. High pressure (all sizes up to 3,000 p.s.i. operating pressures).

Identification markings consisting of lines, letters, and numbers are printed on the hose. (See figure 5–2.) These code markings show such information as hose size, manufacturer, date of manufacture, and pressure and temperature limits. Code markings assist in replacing a hose with one of the same specification or a recommended substitute. Hose suitable for use with phosphate ester base hydraulic fluid will be marked "Skydrol R use". In some instances several types of hose may be suitable for the same use. Therefore, in order to make the correct hose selection, always refer to the maintenance or parts manual for the particular airplane.

Teflon Hose

Teflon hose is a flexible hose designed to meet the requirements of higher operating temperatures and pressures in present aircraft systems. It can generally be used in the same manner as rubber hose. Teflon hose is processed and extruded into tube shape to a desired size. It is covered with stainless steel wire, which is braided over the tube for strength and protection.

Teflon hose is unaffected by any known fuel, petroleum, or synthetic base oils, alcohol, coolants, or solvents commonly used in aircraft. Although it is highly resistant to vibration and fatigue, the principle advantage of this hose is its operating strength.

Size Designation

The size of flexible hose is determined by its inside diameter. Sizes are in one-sixteenth-inch increments and are identical to corresponding sizes of rigid tubing, with which it can be used.

Identification of Fluid Lines

Fluid lines in aircraft are often identified by markers made up of color codes, words, and geometric symbols. These markers identify each line's function, content, and primary hazard, as well as the direction of fluid flow. Figure 5–3 illustrates the various color codes and symbols used to designate the type of system and its contents.

In most instances, fluid lines are marked with 1-inch tape or decals, as shown in figure 5–4 (A).

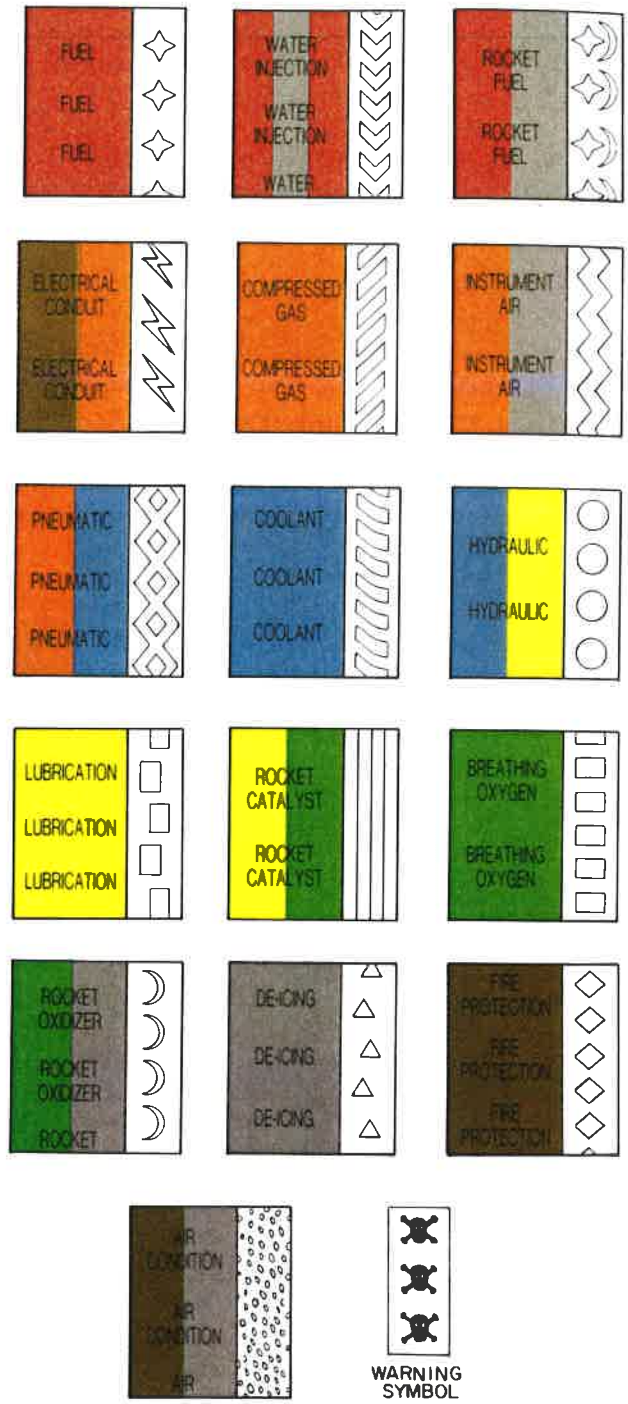
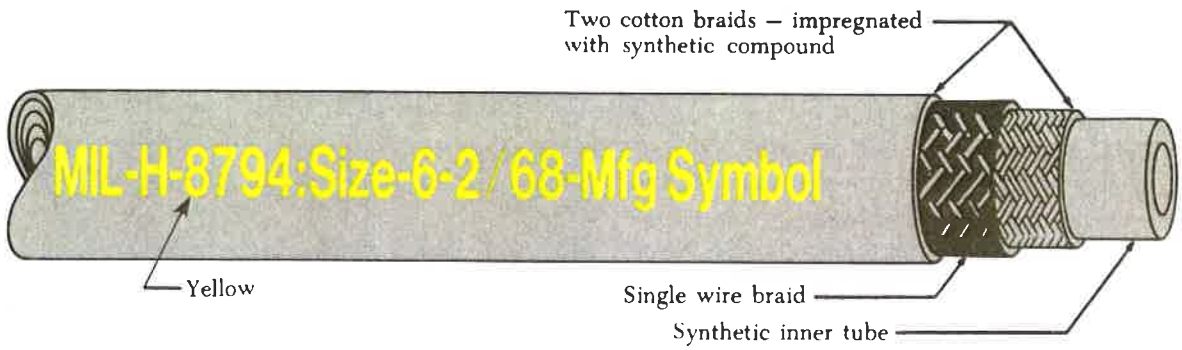


FIGURE 5–3. Identification of aircraft fluid lines.

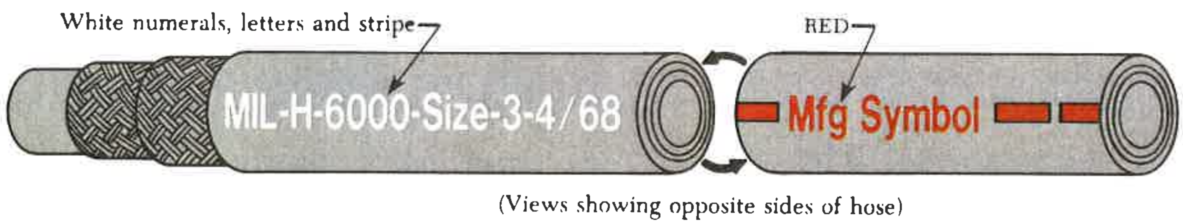
On lines 4 inches in diameter (or larger), lines in oily environment, hot lines, and on some cold lines, steel tags may be used in place of tape or decals, as shown in figure 5–4 (B). Paint is used on lines in engine compartments, where there is the possibility of tapes, decals, or tags being drawn into the engine induction system.

Hoses

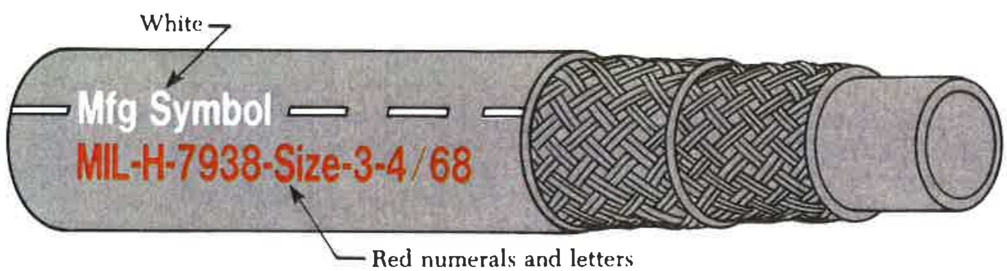
MIL-STD



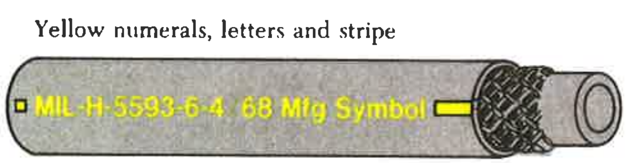
A. Flame- and aromatic-resistant hose



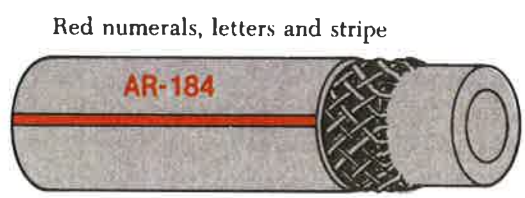
B. Nonself-sealing, Aromatic and Heat-resistant hose



C. Flame-, Aromatic-, and Oil-resistant hose



D. Nonself-sealing, Aromatic-resistant hose.



E. Self-sealing, Aromatic-resistant hose

FIGURE 5–2. Hose identification markings.

AN Plumbing

—— AN744 to AN932 ——

Material:

Aluminum alloy.......... (code D)
Steel.......... (code, absence of letter)
Brass.......... (code B)
Aluminum bronze.......... (code Z—for AN819 sleeve)

Size:

The dash number following the AN number indicates the size of the tubing (or hose) for which the fitting is made, in 16ths of an inch. This size measures the O. D. of tubing and the I. D. of hose. Fittings having pipe threads are coded by a dash number, indicating the pipe size in 8ths of an inch. The material code letter, as noted above, follows the dash number.

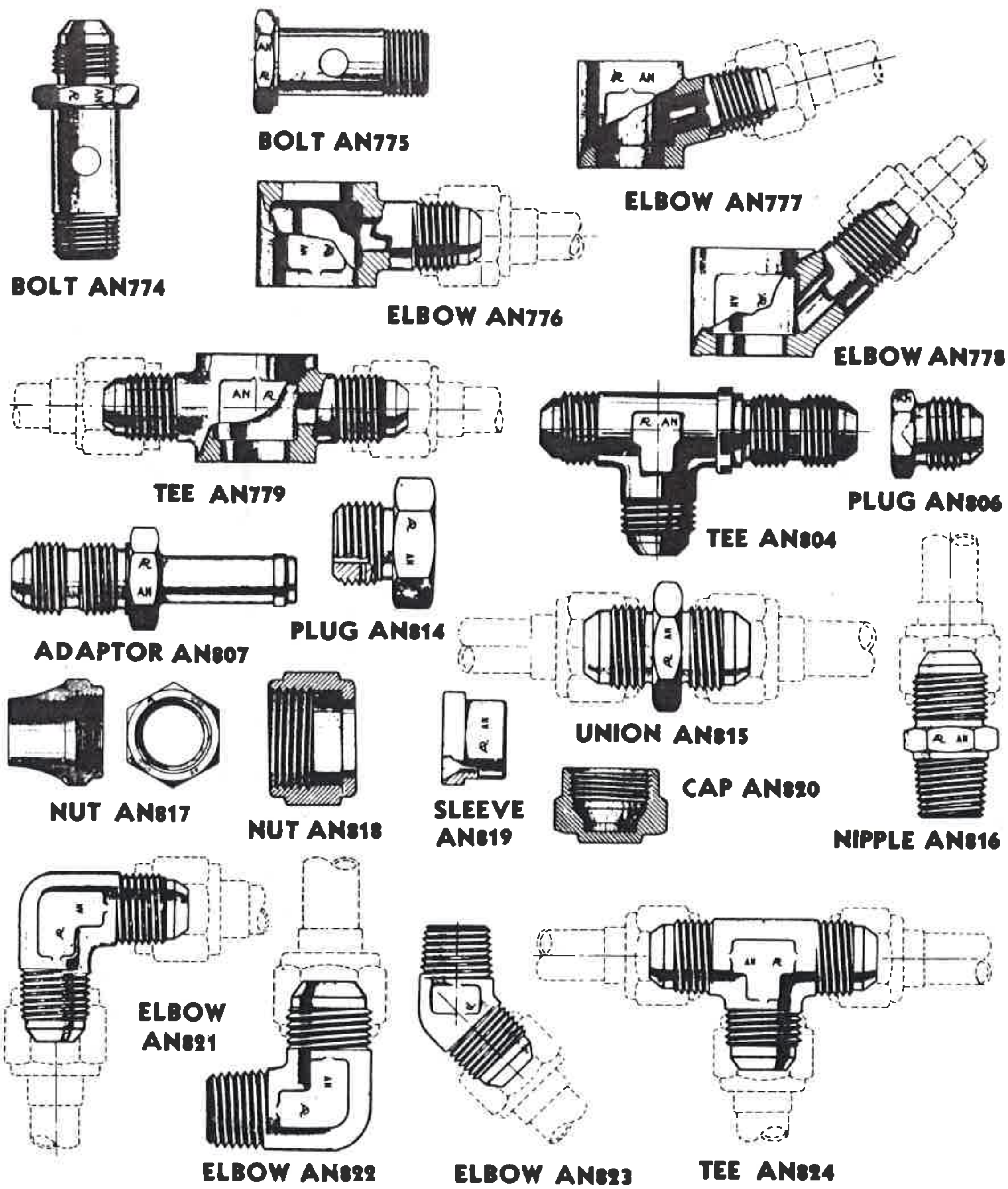
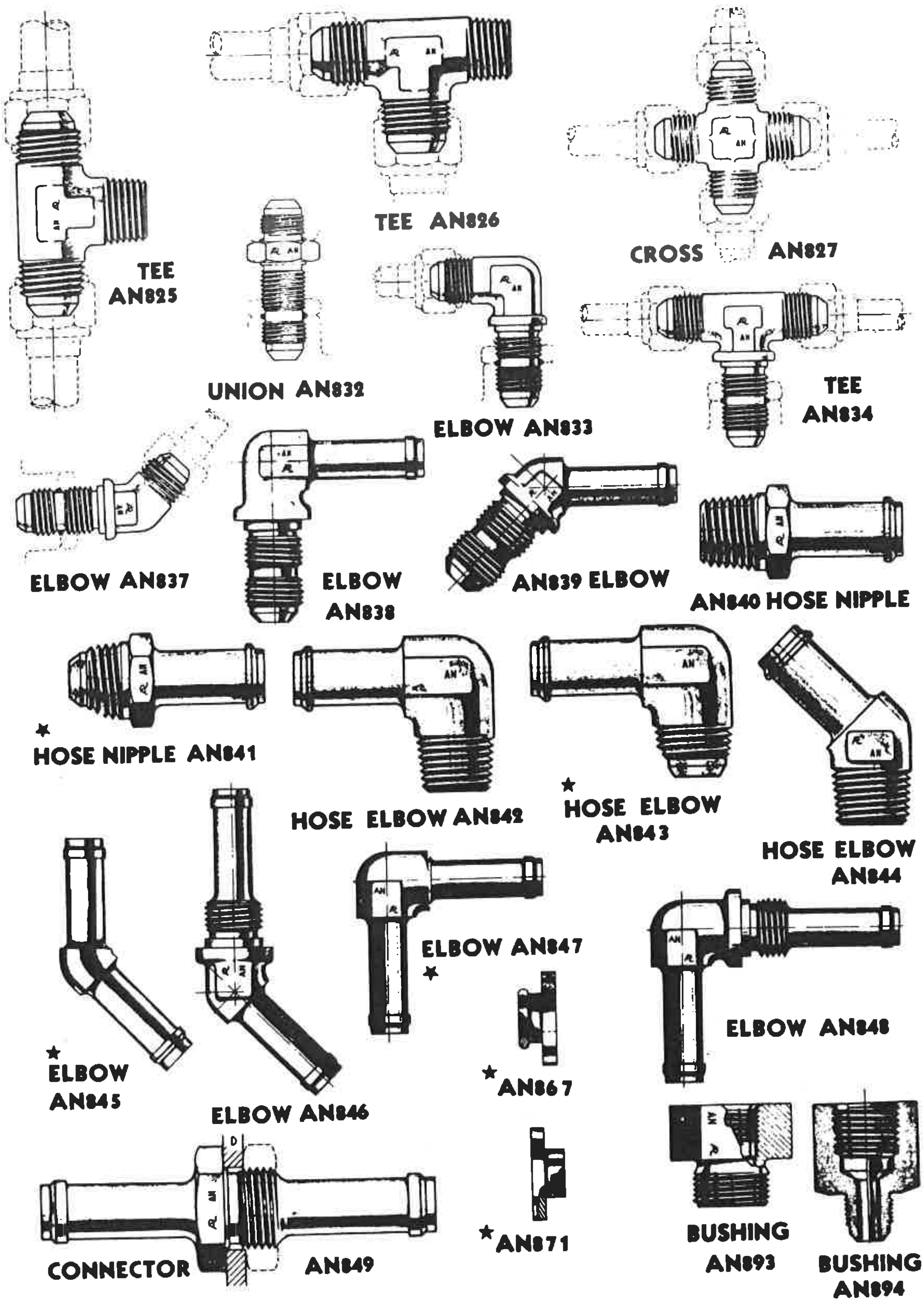


FIGURE 5–8. AN plumbing fittings.

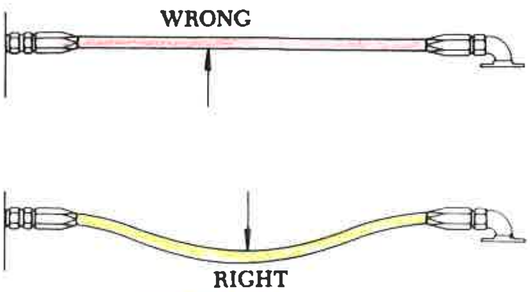


★ Inactive for new design.

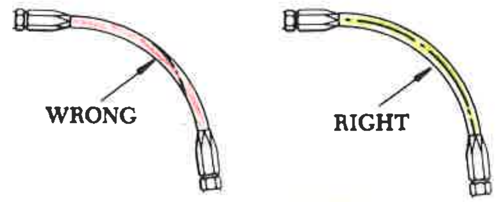
Hose Install Guide

Lockheed SR71 story

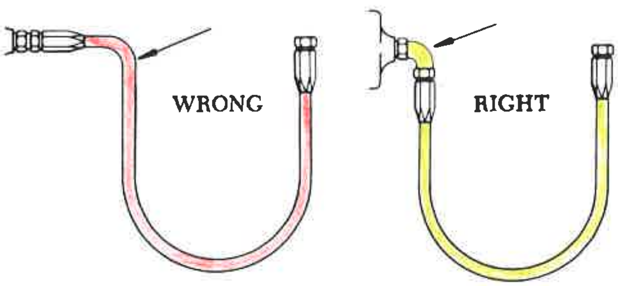
PLANNING HOSE LINE INSTALLATIONS



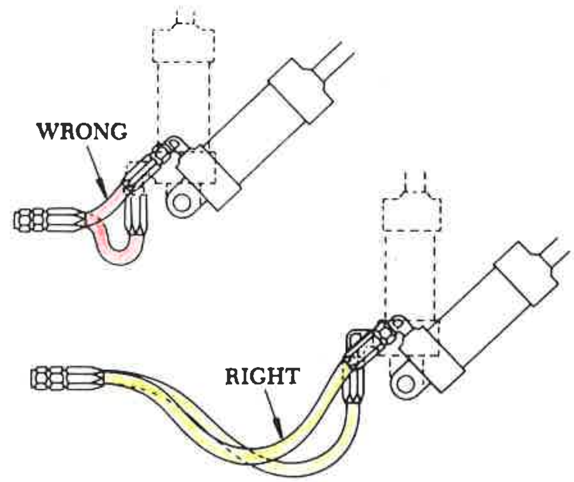
1 . . . provide slack or bend in the hose line to provide for changes in length that will occur when pressure is applied.



2 . . . observe linear stripe. The hose must not be twisted. High pressures applied to a twisted hose may cause failure or loosen the nut.



3 . . . relieve sharp bends, avoid strain or hose collapse and make cleaner installations by using Aeroquip elbows or other adapter fittings. Provide as large a bend radius as possible. Never use less than the recommended minimum bend radius specified for the hose.



4 . . . provide additional bend radius when lines are subject to flexing and remember that the metal end fittings are not flexible. Place line support clamps so as not to restrict hose flexing.

FIGURE 5–19. Flexible hose installation.

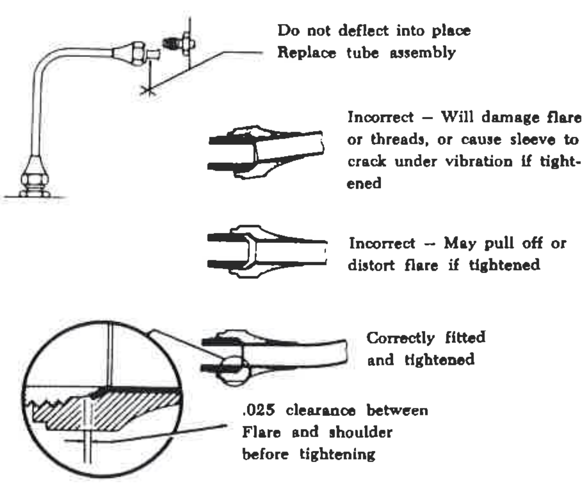
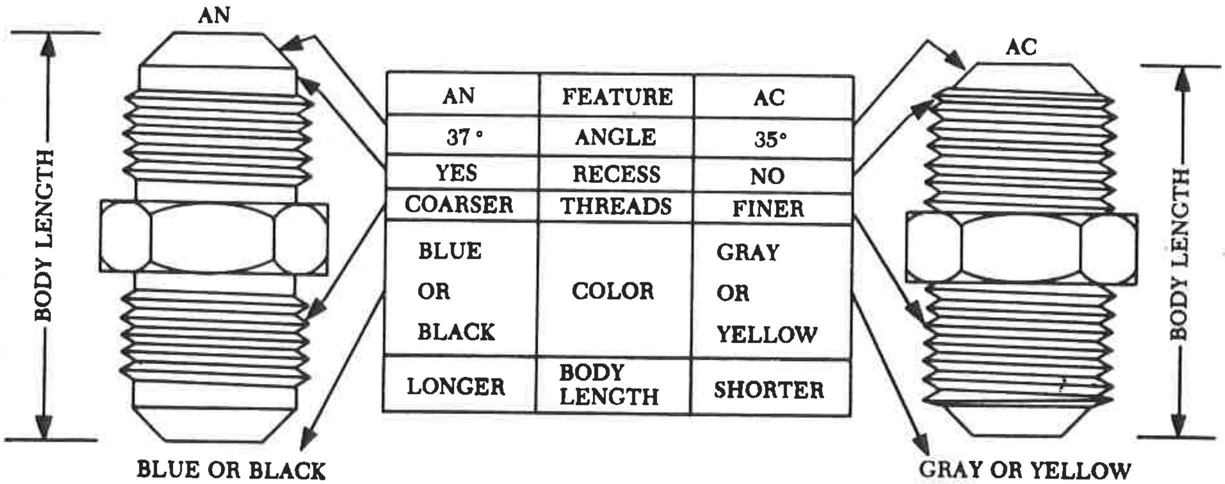


FIGURE 5–20. Correct and incorrect methods of tightening flared fittings.

which is necessary to produce the seal. Be sure that the line assembly is properly aligned before tightening the fittings. Do not pull the installation into place with torque on the nut. Correct and incorrect methods of installing flared-tube assemblies are illustrated in figure 5–20. Proper torque values are given in figure 5–21. It must be remembered that these torque values are for flared-type fittings only. Always tighten fittings to the correct torque value when installing a tube assembly. Overtightening a fitting may badly damage or completely cut off the tube flare, or it may ruin the sleeve or fitting nut. Failure to tighten sufficiently also can be serious, as this condition may allow the line to blow out of the assembly or to leak under system pressure.

The use of torque wrenches and the prescribed torque values prevents overtightening or undertightening. If a tube fitting assembly is tightened properly, it can be removed and retightened many times before re-flaring is necessary.



AN	FEATURE	AC
37°	ANGLE	35°
YES	RECESS	NO
COARSER	THREADS	FINER
BLUE OR BLACK	COLOR	GRAY OR YELLOW
LONGER	BODY LENGTH	SHORTER

FIGURE 5-6. AN and AC fitting differences.

AIRFRAME AND POWERPLANT MECHANICS GENERAL HANDBOOK

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FEDERAL AVIATION ADMINISTRATION

Flight Standards Service

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